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ABSTRACT

These proceedings include the texts of eight papers that were presented at a two-day symposium devoted to new technologies and their implications for vocational and technology education curricula. Included in the volume are the following papers: "Economic Climate and Implications for the Introduction of New Technology," by M. J. Pace; "Technology Change and Social Impact," by Lee Davenport; "Construction," by J. Hutton; "Manufacturing," by D. G. Zook; "Technological Developments Energy Research," by Anthony Gorski; "Communications," by Lee Davenport; "Transportation," by Phillip Mazziotti; and "Curriculum Implications for Technology Education--1990," by G. Eugene Martin. (MN)

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Technology Education Symposium IV

Conference Proceedings

Illinois State University
Normal, Illinois
October 22 & 23, 1982

New Technologies and Implications for Curriculum

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Foreword

The Technology Symposium concept originated with two of our colleagues at Eastern Illinois University in 1980. . . John Wright and Ronald Jones. Their thinking was to bring together industrial educators at various levels who were truly concerned with the technological education of people. They envisioned presentations and discussions that would go well beyond the focus on discrete technical skills and activities but rather would focus on new ways of conceptualizing and structuring the knowledge areas in technology to better promote technological literacy among our youth. This basic theme has continued as the underlying purpose of subsequent symposia. Technology Symposium II was held at the University of Wisconsin Stout in 1981. Symposium III was held at Ball State University in Muncie, Indiana in the fall of 1981.

Illinois State University was committed to carry on the theme in Technology Symposium IV. The Conference was structured around the topic of, "New Technologies and Implication for Curriculum." To this end, leading scientists and industrialists made presentations over the course of two days from the perspectives of their disciplines. A lot of interaction took place, and the conference was brought to a focus by a leading industrial educator.

This booklet is a summary of the two day conference.

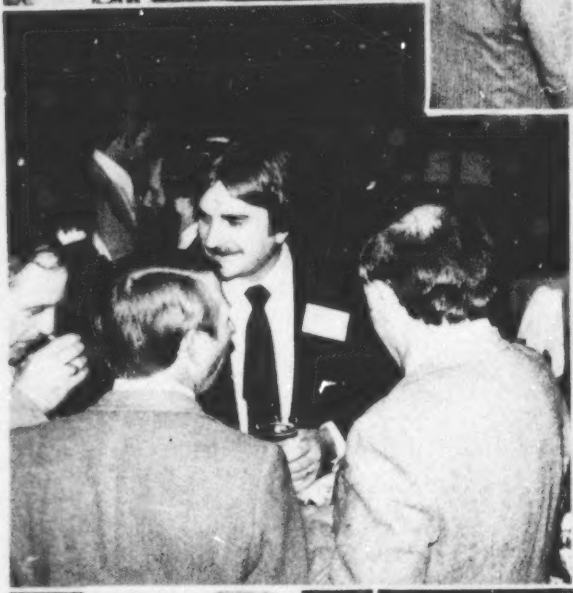
Wayne Andrews & Larry Miller
Co-Directors

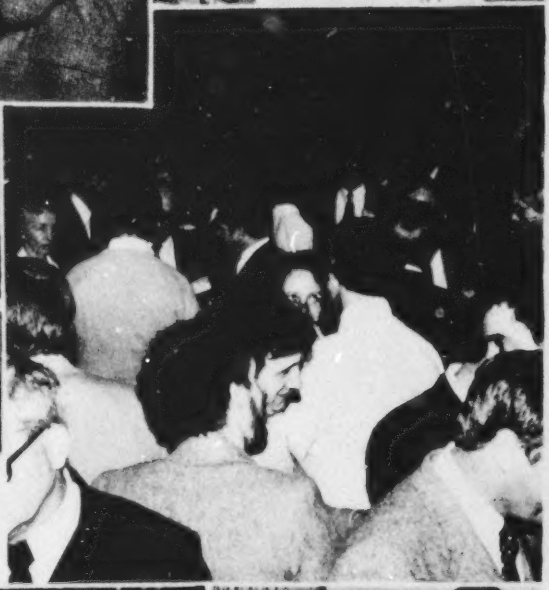
Setting the Stage

Welcome

People began arriving for Technology Symposium IV Friday afternoon. After registration in Turner Hall, tours were provided of the Industrial Technology facilities. Following the tours the participants had an opportunity for fellowship at the cocktail hour.

The Conference was officially opened during the evening banquet. Dr. Edward Anderson Dean of the College of Continuing Education at ISU welcomed the participants on behalf of the University administration. Wayne Andrews introduced the head table, provided the group with a historical overview of the symposium concept and reviewed the Conference agenda.





Economic Climate and Implications for the Introduction of New Technology

M.J. Pace, Vice President and Controller of the First National Bank of Normal, Illinois, received his M.S. in accounting at the University of Illinois. He completed the graduate school of banking at the University of Wisconsin and is a chartered bank auditor. Mr. Pace is on the faculty at Illinois Wesleyan University, past president of Normal Chamber of Commerce, past president of Bloomington-Normal Clearing House Association and past president of the McLean County Bankers Federation.

Mr. Pace emphasized that he is not an economist, but rather a banker, a businessperson, and an educator. He presented a synthesis of economists' views from the perspective of a businessperson, while relating remarks about the economy to technology and technological development. The present economic climate, while not good, may be slowly improving, though with considerable uncertainty. Interest rates have declined. The current prime interest rate is 12%, and it is expected to remain at 12% to 13% for 1983. Inflation should remain at 6% through next year. Primary threats to economic improvement include: the government's continued deficit spending, natural gas prices, and the defense spending. Other threats to economic growth include: 1) the increase in unemployment to a record 18+%, 2) the decline of the gross national product, 3) the increase in bankruptcies with nine out of ten new businesses failing within five years, and 4) a decrease in capital spending from the current 5% decrease to a further 8% decrease in 1983. Couple this with a weak increase in consumer spending and a too slow increase in housing starts, and this leads to the following economic overview: the stock market is showing signs of recovery, interest rates are declining and likely to remain at acceptable levels, inflation will be back to single digits for the foreseeable future, Federal deficits are still a threat, high unemployment is likely to continue, the GNP is essentially stagnant, there is a record number of bankruptcies, modest increases in disposable income may be in the future, there are encouraging trends in consumer spending, housing starts are increasing but still short of excellent, and the outlook for capital spending is gloomy.

There are some bright spots in the economic future. Spending for R & D has increased 12%, to $78 billion, over the last year. Two-thirds of American industries plan to develop new research facilities over the next five years, and four out of five companies plan to increase their research efforts. This increase is spurred by competition, changing technology, and aging facilities. Increasing research will be conducted in the areas of biotechnology, gene-splicing, pharmaceuticals, and instrumentation. Large companies are growing through mergers and acquisition of smaller firms. Large firms spend more on R & D than do smaller companies.

While the economy's effect on R & D has been favorable, its effect on production has been very negative, primarily because of weak capital spending and unemployment. More than a million jobs have vanished permanently since 1978. We can expect declining demand for assemblers, molders, spray painters, textile workers, boiler tenders, machine-tool operators, tool-and-die makers, and electroplaters. The following industries are disappearing or fading in significance: the garment business, textiles, shoe

factories, steel, autos, rubber, mining, railroads, and manufacturing in general. There will, however, be a shortage of trained workers in computers, accounting, banking, engineering, economics, physics, law, and health care.

Technology can help overcome some of the problems facing production by creating new methods of production such as robotics, computerization, and other electronic-aided production methods; and by promoting new methods of instruction such as microcomputers and video classrooms. Technology will help produce the following lifestyle changes: 1) nationwide automated teller machine networks; 2) debit card gas pumps; 3) telephones as terminals; 4) the use of video terminals to bank, shop, and work at home; 5) the creation of offices without desks; 6) electronic transmission of voice, image, and discussion materials replacing the need for conferences; 7) electronic mail; 8) the availability of product and comparison information at home via video terminals; 9) commercial satellites making telecommunication a worldwide commodity; and 10) the "smart card" with an implanted microchip to provide bank credit at various stores.

These changes in our lifestyle, coupled with the many changes in production will encourage the introduction of new technology relating to: the manufacture, maintenance and repair of robots and computers; the development of synthetic fuels, insulation, and other ways of dealing with fuel shortages and higher fuel costs; the creation of equipment which will be more efficient, laborsaving, reliable, and have a longer service life; medicine, and health care; and the delivery of information, education, and financial services.

In conclusion, the economic climate is conducive to the introduction of new technology. We must utilize technologies of today and tomorrow to put people to work, and to produce exports to balance the increasing imports of goods now more economically manufactured abroad. Indeed, the economy, in its weakened state, needs the continued introduction of new technology to aid its recovery.

Host: Dr. Frederick Kagy
Recorder: Dr. Dennis R. Mueller

Technological Change and Social Impact

Lee Davenport, a consultant in telecommunications planning and advanced technology, retired from General Telephone and Electronics Corporation (GTE) in 1981 after having served as chief scientist at the corporate headquarters in Stanford, Connecticut. His duties at GTE included interpreting new technology and forecasting future trends in telecommunications, acting as corporate spokesman with respect to technical areas of interest to GTE and providing advice and counsel to the overall GTE organization on future trends in technology.

Dr. Davenport introduced his topic by speculating on what a speaker in a similar situation one hundred years ago might say. In 1882, a speaker addressing the topic of technological change and social impact might start with a statement such as "we are living in an exciting age with many scientific discoveries and technological developments that are having a tremendous social impact." He might go on to cite several examples. The reaping machine invented by Cyrus H. McCormick in 1834 has unquestionably changed life on the farm. The development of the steam locomotive revolutionized transportation. The invention of the first commercial electric elevator by the Otis Elevator Company in 1889 changed forever the field of architecture. Although the full impact was not immediately known, society was changed in 1859 when Edwin Drake drilled for and found oil. Finally, the field of communications was changed when, in 1837, Samuel F. B. Morse developed the telegraph. The speaker might then conclude with the observation that life in the U.S. has been improved by technology. Given the wide-spread belief in 1882 that science was a mature subject, the speaker might have given the impression that little remained to be developed. How wrong he or she would have been!

The period from 1882 to 1900 includes the development of the telephone, radio, electric lights, x-ray, diesel engine, automobile, motion pictures, vacuum cleaner, and aluminum. The social impact of these inventions and developments continue even to the present.

Dr. Davenport then made the observation that, in 1982, we are much wiser for the experiences of the past 100 years. There is a realization that much remains to be discovered and developed. Forecasts of such events may not be any clearer than in the past, but society's understanding and acceptance of a future that is different from the present is much improved.

According to Dr. Davenport, a major difference between 1882 and 1982 is the pace of technology. It was nearly 25 years after the invention of the automobile before the Model T Ford appeared with its great social impact. Fifty years after the development of the steel plow and reaper, 50% of the work force was still required in agriculture to support the population. In 1932, technological change is coming very fast. While the future is uncertain, society can expect developments in such areas as genetic materials, economic systems for solar energy, hydrogen fuel from water, nuclear fussion reactors, etc. The social impact of each of these will be felt much more quickly than would have been true 100 years ago.

Rather than speculate on the future, Dr. Davenport chose to focus his address on today's technology—since, in his opinion, so much that is known is undeveloped. While a number of different technologies could have been used to illustrate the impact technology has on society, he elected to use the "information revolution." According to him, this is probably the single "hottest" technology in terms of social impact.

The information revolution is not new, we have been going through it for a long time. However, according to Dr. Davenport, the introduction of digital electronics and integrated circuitry has accellerated the pace dramatically. The big changes are still ahead. At the heart of the information revolution will be cheap electronic storage and the rapid exchange of data and information. Currently, paper is the limiting factor on communications. When electronic storage becomes much cheaper, something that is coming very fast, we will have to re-think the way we think and communicate. Speed of communications will be very important in the future.

Two factors were cited by Dr. Davenport as being responsible for the changes that are occurring. The first is digital technology. We are rediscovering the value of pulses. Pulse technology dates back to 1837 and the work of Samuel F.B. Morse. Dr. Davenport noted that the telegraph was the first instantaneous electrical data communications system. Alexander Graham Bell was experimenting with a system to multiplex five signals over a single wire when, by accident, he discovered the telephone. The telephone, at that time an analog communications device, rapidly replaced the pulse-based telegraph.

The second factor is microelectronics. The progression in microelectronics started with the transistor and then evolved in succession, integrated ciruits (IC), large scale integration (LSI), very large scale integration (VLSI), VVLSI, ULSI, etc. Dr. Davenport remarked that some of the newer generations of high density integrated circuit designs may have to wait for the development of new IC production technologies.

Three products of major importance to the information revolution have resulted from the interaction of digital technology and microelectronics. One such product is the computer, which Dr. Davenport considers as evidence that the "marriage of digital technology with integrated circuits is a happy one." The computer industry is growing at a rapid pace. He also noted that the telephone industry is experiencing parallel growth.

A second product cited by Dr. Davenport was digitized telephone voice communication. Approximately 50 percent of the current telephone traffic is digitized, transmitted, and then reconstructed at the receiving station. Each line is able to carry 23 "voices" at one time, with transmission rates of 1.544 millions bits/second.

The third product identified was electronic mass memory. Some of the technologies, such as bubble memory have not progressed as rapidly as anticipated. However, MOS, CMOS, and other technologies have produced increasingly dense memories at decreasing costs.

A question might be raised in regard to the importance of all the information that is being generated, processed, and transmitted. In other words, is there a need for an information revolution. Dr. Davenport identified three basic reasons for this revolution. First, the structure of the labor force. Approximately 5 percent of the labor force is engaged in agriculture, another 35 percent in blue-collar occupations, and 55 percent in white-collar, i.e., information and service occupations. Second, our nation is part of a global economy—and we are not doing well. For example, look at the television industry, automobile industry (35 percent are imported), or try to buy an American-

made camera. We are losing our manufacturing edge. Third, the information revolution is needed for automation and as a means to increase productivity—particularly in the white-collar area. A large part of the cost of any product comes from white-collar components, i.e., overhead. Yet much of the effort to automate is focused on blue-collar occupations, which account for only 35% of the labor force. The current high interest in robotics would support this point.

The building blocks for the informations revolution will include:

Computer output—paper and magnetic tape. Dr. Davenport noted that a single magnetic tape could hold enough information to fill a stack of computer pages 24 inches thick.

Video disks—when combined with laser technology, a disk can store 20,000,000,000 bits of data (i.d., 2×10^{10} bits). Information, pictures, and data would be stored as bits. This would be equivalent in storage to 2000 400-page library books, or 500 standard telephone directories (50 Manhattan telephone books). A single disk costs less than $15.00, which is cheaper than most books. Currently, the information is not instantly available. You have to search the disk for it.

Computer memory—20 years ago 400 bits of core memory cost $150.00. Today most Radio Shack stores will sell you 4000 bits of memory for less than a dollar. Using current technology, 5 megabyte memories appear to be the limit (1 byte = 8 bits). Once the limit is reached, new technologies will need to be developed. Memories of this capacity are coming and will not be expensive.

Microprocessors—i.e., computers on a chip. The telephone company buys microprocessors in quantities for less than $5.00 each. They are appearing as integral parts of many products—particularly in the communications industry.

Dr. Davenport then traced, using slides, the evolution of the information revolution, the highlights of which included the following items:

Paper—we start with libraries and reference centers and accumulate information that is often stored on someone's desk (and not too neatly at that). From the desk it is filed and then archived. If it is to be shared with others at some distance the Postal Service is prepared to "speed" it on its way. Convenient curb side terminals are made available to users of this service (i.e., mailboxes). Unfortunately, as rates increase, service has decreased. Dr. Davenport observed in passing that the new 9-digit ZIP code would permit every man, woman, child, cat, dog, etc. to have their own personalized code.

Telegraph—Samuel F.B. Morse developed the Morse Code in 1844. The pony express, started in 1859, lasted only 19 months before the telegraph put it out of business. Communication systems that are too slow will be replaced by faster ones.

Integrated circuits—the invention of the transistor lead to the development of integrated circuits which have served as the foundation of change. In 1960 IC's had very few components and cost approximately $100. By 1964, 16 bit memories were available and were the size of a dot. In that same year, RCA put an analog IC chip costing 60 cents in their T.V. sets. Currently, 4K, 16K, and 64K memories (K = 1024 bits) are available and are no larger than a paper clip. To produce these memories using other than IC technology would require the soldering of over 500,000 wires—a task that would be difficult to do reliably and cheaply.

Microprocessor chips—in 1976 INTEL developed the 8080 microprocessor which was much more complex and detailed than any that preceded it. By comparison, the IBM 1130 Computer of approximately ten years earlier had about the same power as the

INTEL 8080. However, th INTEL 8080 chip costs about $5.00. Each year for the past ten years the density of co ponents on chips has doubled. This trend is expected to continue in the future.

Magnetic bubble memories—magnetic bubble memories have not developed as quickly as projected, but have excellent potential for providing low-cost, high density, electronic memory. A one inch cube of bubble memory should be able to store the entire contents of the *Encyclopedia Britanica*.

Dr. Davenport went on to identify a number of examples in current usage that are dependent on information revolution technology. Included were: word processing, electronic funds transfer, automatic teller machines, an electronic facsimile transmission. He noted that the most visible outward symbol of this technology is the terminal. They can be found almost everywhere: travel agencies, hospitals, schools, car dealerships, libraries, etc. He did note one possible problem that he has experienced. To use the electronic mail system available to him requires that 54 keystrokes be entered in sequence without error. He would like a system that he could simply talk to in order to store and retrieve messages. The real social impact of the information revolution will come when this technology reaches the home. In England, a system known as View Data is available in some homes and is progressing very nicely according to Dr. Davenport. GTE has adopted a similar system and made it available on a limited basis. The GTE system is menu driven, making it easy to use. Dr. Davenport related an experience he had in using the system to locate a restaurant. With the aid of the system, he was able to identify the section of the country, city, type of food, price, and other information, and it then gave him a listing of restaurants that met his requirements. Networks such as this exist and have available games, reservations, programming languages, stock market analysis, and a variety of other services.

Among the social implications cited by Dr. Davenport were that we will be able to shop at home, work at home, the elderly will be able to bank at home, education will change (methods, access, equality, etc.), and the entire communications process will move to an electronic versus paper basis system. In France, the government is considering a proposal to provide all its citizens with terminals.

In summary, Dr. Davenport reiterated the point that much remains to be done before the full impact of the information revolution is realized. The technology and tools are coming very quickly, the impact will be felt much more quickly than has been true of developments and inventions in the past, and that the biggest changes are still ahead.

Host: Dr. Stan Aman
Recorder: Dr. Wayne Lockwood

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Construction

J. Dennis Hutton, president of the Illinois Home Builders Association, has been actively involved in all phases of construction over the past twenty years. A graduate of the University of Illinois with a specialty in industrial design, Mr. Hutton has built a very successful business specializing in single and multiple family homes and light commercial construction. He is a part-time teacher at Parkland Community College and is active in the Home Builders Association.

Mr. J. Dennis Hutton is president of the Illinois Home Builders Association and has been actively involved in all phases of construction over the past twenty years. A graduate of the University of Illinois with a specialty in industrial design, Mr. Hutton has built a successful business specializing in single and multiple family homes and light commercial construction. He is also a part-time teacher at Parkland Community College in Champaign, Illinois. The following is a summarization of his presentation on the construction industry made during the Symposium IV at Illinois State University.

The major theme of the presentation was "New Technologies in Construction." Three phases of the construction industry were used to elaborate on innovations that are occurring in this business. The three phases consisted of the following: production, marketing and finance. The main point emphasized was that the innovations in these three areas really aren't all that new. Some of the examples that were given have been around for years, but they haven't been used because the economy was in a better situation prior to this time. In the area of marketing raffles are being used to help sell houses, and in finance there are about thirty different ways to purchase a house today.

One of the primary concerns of many people in the construction industry is when will business return to normal? To address this concern, the audience was shown a transparency indicating the good times and bad times for the construction industry. The transparency showed the number of houses built in the past from the year 1900 to the present. According to the chart, the housing industry peaked every twenty-five years. These peak years were 1925, 1950 and 1975. Based on this, Mr. Hutton predicted that the next building peak will be about the year 2000.

The guest speaker then went on to show a transparency indicating the population growth of various age groups from the year 1900 to the year 2000. He indicated that multifamily housing will be a popular style of housing for the future. People will look to these types of living quarters because of the new family formations occurring and the desire for less maintenance. Amenities such as swimming pools, and workout rooms will also be popular items in the future.

The next topic focused on in the presentation was something referred to as the "attitude of buying" for the twenty-six to thirty-four year old age group. This is the age bracket where couples traditionally have gone out and purchased their first house. Today all sorts of social changes in our society are altering this tradition. The increase in the divorce rate, new family formations, a trend towards smaller families, married professionals, single professional people living alone, and people moving out of certain areas of the country were some of the social changes mentioned that are dictating the demands for housing today. As a result, new trends in housing are developing. The

following is a list of the trends stated: 1) single family houses with two master bedrooms 2) a glut of single family houses in some parts of the country where the population is not increasing 3) couples buying one dwelling located where they work and a second dwelling in an area of the country where they enjoy their free time 4) the need for smaller separate dwellings for divorced couples.

The last part of the presentation pinpointed where the building industry is going in the future and the training people will need to stay in this business. The trend will be toward larger construction businesses and larger buildings. The glut of houses on the market will dictate building big apartment complexes with all the amenities. The trend may get to a point where 90% of the production is performed by 50% of the builders. Construction businesses in the future will need to identify their markets better than they do now. Knowing what and where to build will be most important to their survival. This will also determine the application of new technology. As for training, it was recommended that a student specialize in a specific area of construction. Larger construction businesses will have their own finance manager, marketing manager, production manager, supervisors and on the site workers. Future builders should be prepared for larger construction businesses because that is where a lot of the jobs will be. According to Mr. Hutton, construction companies will keep on getting bigger and there will be less small builders.

The guest speaker summed up his presentation by stating that there is a bright future for the construction industry, but that it will not consist of traditional building as in the past. Time was allowed at the end of the presentation for questions from the audience.

Mr. Hutton was asked what he was doing to prepare himself for the future. He replied that he was staying with the idea of operating as a small businessman. One of the key things he was trying to do was become a better manager of his business. He is spending more time on tasks like drawing up plans and selling the product rather than doing a lot of constructing.

Two questions were asked pertaining to the development of curriculum in the construction area in two and four year institutions. The response to both these questions was that the emphasis should be placed on business management type courses such as business law, accounting, marketing, math, and English. Courses in mechanics and materials science should also be offered along with the business courses.

One of the people in the audience also asked where we will get all the craftsmen needed for the construction industry. Mr. Hutton stated that in the future there would be problems in obtaining sufficient manpower and materials. He also noted that there are a lot of young people in the business today who are not permanently employed. These young people are coming out of two and four year institutions and are better educated than workers in the construction industry of the past. His opinion was that these people would meet the manpower needs of the future and that most of the craftsmen would come from community colleges.

The guest speaker ended his session by telling the group that the National Home Builders Association will help set up curriculum in the construction area. He encouraged educators to contact their local chapter if they are in need of some assistance in updating their curriculums.

Host: Dr. Wayne Nelsen
Recorder: Mr. Kenneth Stier

Manufacturing

Mr. D. Zook is currently Manager of Manufacturing and Materials Development for Caterpillar Tractor Company's East Peoria plant. He received his Bachelor and Master degrees in Engineering from the University of Illinois and taught at Bradley University for ten years. He is a Registered Engineer in Illinois and Pennsylvania and currently serves as Secretary-Treasurer for the Society of Manufacturing Engineers.

Mr. Zook opened his presentation with an overview of the function of his department within the Caterpillar Tractor Company. Manufacturing and Materials Development is charged with improving the productivity of the manufacturing system by identifying those areas where the new technologies and improved materials may be best utilized. Currently Caterpillar's emphasis has been to improve the workplace for their employees by placing robots at those jobs that are dangerous or unpleasant because of heavy physical demands or hazardous work environment. A side effect has been the increase in productivity because of the robot's ability to work at a steady pace as compared to the human's diminishing productive rate due to fatigue. Heavy emphasis is being given to the development of systems that employ robots in material handling, machine loading, painting and welding.

An example of the materials development area is the increased use of powdered metal parts. Powdered metal is not a "new" technology, as pointed out by Mr. Zook, what is new is the growth in the size and weight of the powdered metal parts that are being used in industry. Powdered metal parts in the past were restricted to small sizes weighing three ounces or less. Today, parts weighing as much as five pounds are being processed.

A video tape "The Leading Edge" produced by Caterpillar, was shown to illustrate some of the recent work done by the Manufacturing and Development Department. The following is a brief summary of several of the projects reviewed by the tape.

The fuel injector return springs supplied by an outside supplier had shown an unacceptable failure rate. By using current technology in an innovative way the Development Group provided a group of machines that produced the required springs, in-house, to meet specifications at a lower cost. The system included an eddy current tester with computer memory that inspected the wire as it was fed into the spring winder. Any faults detected in the wire were stored in memory and the spring containing the fault rejected when it was coiled. After heat treatment the springs are 100% inspected, automatically, at the rate of 1000 per hour. Result: In-house manufacture with better quality control and lower cost.

The cutting of heavy steel plate is a major operation in the manufacture of heavy earth moving equipment. Equipment has been developed using a plasma arc submerged under water. Result: Increased cutting speed, 140" vs. 22" per minute using oxyacetylene torches, cleaner cuts with less dross, less distortion, fewer particulates and less noise producing a more pleasant work environment.

The development of a robotic system to orient track links for further processing was one illustration of removing workers from unpleasant and physically debilitating jobs. Presently many persons are employed to sort and orient track links weighing as

much as 50 pounds apiece. Errors caused by fatigue and boredom plus lost time caused by injury make this operation a priority for automation. Result: Elimination of errors in track link orientation, and opportunities for increased productivity.

A further example of the use of high technology to remove workers from dangerous environments was the development of robotic painters using electrostatic spraying equipment. Current OSHA standards required the development of new more costly paints. The previous manual process of spray painting still exposed the painter to hazards and was wasteful of paint. Using robots equipped with electrostatic painting equipment provided a constantly controlled paint film to all surfaces of the transmission case without exposing the workers to the dangers of the spray booth. Results: Greater production, elimination of worker exposure, better control of paint film, 50% paint savings.

The manufacture of heavy earth moving equipment is dependent on efficient fabrication of many pieces of steel plate by various welding processes. Under the best manual welding conditions the worker is only able to "lay bead" less than 50% of the work time. The remaining portion of the work day is spent positioning pieces, adjusting protective equipment and changing rods. One job that formerly required 41 minutes of human labor is now done by robotic welders and requires only 20 minutes. A tack welding operation, done by a human welder, is carried out in an adjacent work station prior to the robot welder completing the fabrication. Results: Doubling of weld bead laid down per unit of time, reduction of distortion caused by interrupted welds necessary in manual welding operation, distortion from welding heat is predictable and the exposure of humans to the dangers of welding atmosphere is reduced.

Mr. Zook's presentation concluded with the audience participating in a question and answer period. A majority of the questions centered around the use of robots and flexible manufacturing systems and their impact on the work force. As Mr. Zook views the present situation, the robot will replace the worker not yet hired. He does not see a heavy industry such as Caterpillar operating a totally unattended factory. The assembly of machinery involves visual and tactile senses which is an aspect of robotics that has seen limited developmental progress to date. There will likely be fewer "wrench turners" in the manufacturing operation but the future work force will need an understanding of computers and computer programming. An operation the size of Caterpillar will operate with in-house maintenance crews to service the computer controlled machines that will be common throughout the facilities. Some of the people will be upgraded from their present jobs, others will be new hires.

Mr. Zook commented on the current problems of tying all the machinery together in a communication network when designing a flexible manufacturing system. Since there are no standards among machine manufacturer's the language problems become bothersome. People that are knowledgeable in the interfacing of machines, robots and their control equipment will be very desirable in the future.

With the current corporate emphasis on automating those jobs that are hazardous, unpleasant or boring the worker does not fear robots. The workers whose jobs have been taken over by robots have the attitude of "good riddance" to an unpleasant job. In most cases they have been moved to jobs that are safer, more pleasant and more rewarding. As this philosophy continues the workplace will become safer, more pleasant and more productive.

Host: Dr. Gary Weede
Recorder: Dr. David R. Pontius
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Technological Developments
Energy Research

Anthony Gorski, research scientist at Argonne National Laboratory, Argonne, Illinois, received his B.S. in physics at the Illinois Institute of Technology and M.S. from DePaul University. A registered professional engineer, he is currently the principal investigator in the Ice Storage for Cooling Applications program and is involved in advanced photovoltaic and photothermal collector design and construction.

This lecture-slide presentation focused on three unique means of harnessing solar energy. The first discussion included nonimaging solar concentrators intended for industrial applications. The second topic reviewed was the use of passive solar techniques via a solar pond using salt gradient as a liquid collector medium. Rounding out this presentation was a progress report on current research involving long-term ice storage for cooling applications using passive freezing techniques.

Numerous industries require and consume process heat temperatures above what a conventional flat plate collector can deliver. Since industry and power generation activities consume approximately one-fourth of the total consumed in the U.S., there is substantial sentiment that finely engineered concentrating solar collectors must be developed to allow solar energy to be worthy of consideration for high temperature applications.

Although there are numerous types of collector designs this discussion will include only research information collected at Argonne National Labs, Argonne, IL, with reference to nonimaging solar concentrators for high temperature applications.

There are two types of concentrators: a) nonimaging concentrators that do not focus the sun and b) imaging concentrators that operate on a principle similar to a focusing lens of a magnifying glass. This presentation centered on nonimaging collectors.

A stationary reflector placed next to a flat plate collector is the simplest nonimaging concentrator. The reflector increases energy collection per unit area and will slightly change energy collection per unit of area. To optimize a nonimaging concentrator potential, a Compound Parabolic Concentrator (CPC) was developed and tested at Argonne National Labs. This type of concentrator optimizes the acceptance angle as opposed to the concentration ratio, thus yielding the theoretical maximum allowed by thermodynamics.

The wide acceptance angle of a CPC is noted for three major advantages: 1) operation for extended calendar periods without major tracking adjustment (a focusing collector should be moved daily); 2) reduction of cost for the mirrors without sacrifice in the energy collection efficiency; 3) collection and concentration of a portion of the diffuse radiation.

Advantages one and two listed above have direct implication toward lowering manufacturing costs whereas number three is of utmost concern for application in areas that have natural haze and man-made pollution which reduces the amount of solar beam radiation.

Heating and cooling buildings require temperatures from 140-300°F for efficient operations. The 140°F applications include space heating and domestic hot water. Further, the 300°F heat is projected to be useful for operating solar powered cooling units. These temperatures can be met with a 1.5x totally stationary C7C collector requiring no tracking or adjustment for year-round operation.

Process heat temperatures for industry may range from 250-450°F. A concentration ratio of 2.5-3.5x can supply this range provided the concentrators can be adjusted for tilt approximately four times per year. Temperatures above 450°F can be efficiently generated using 5x CPC concentrators. Monthly 'fine tuning' of the tilt angle is needed but normal preventive maintenance schedules could accommodate these procedures. Additionally, recuperation of waste heat from the generating cycle could also be used for lower level heating or cooling applications.

The performance advantages of optimized nonimaging concentrating solar collectors have been demonstrated with a laboratory prototype. To date, efforts to bring these collectors into mass production are being pursued. If commercialization of this technology is successful, application of solar energy to a larger segment of the market is a worthy goal.

The second segment of this presentation was about concepts, features and research efforts regarding salt-gradient solar ponds. A salt-gradient solar pond combines the collection and storage of solar energy into one single operation. Solar radiation is absorbed and stored in the water at the lower levels of the pond. The water temperature at the lower levels of the pond can be as high as 70-90°C (160-194°F), while the surface temperature remains very close to the ambient air temperature. Convection is prevented by establishing a salt-gradient in the pond such that the salt concentration varies from zero at surface to 20% at the bottom of the pond. As a result of the presence of the salt gradient, the fluid density at the lower levels of the pond is higher than that near the surface, thus preventing the hotter fluid at the lower levels of the pond from moving upward. The concept of collecting and storing solar energy by means of salt-gradient solar ponds was derived from studies of various natural lakes that had a salt concentration gradient. A salt-gradient solar pond normally consists of three zones: a thin convective zone at the surface, a non-convective gradient zone that provides thermal insulation in the middle, and a convective storage zone at the bottom. The pond collects and stores solar energy all year-round and the available thermal energy in the pond can be extracted via a heat exchanger for various uses.

The ANL Research Solar Pond is 180 ft. x 80 ft. at the top with tapered sides and a depth of approximately 12 ft. It contains approximately 800,000 gallons of water and 700 tons of salt. A plastic liner is used to prevent leakage of the salt water into the surrounding ground. In the course of a year, the pond can provide approximately 10^8 BTU (2.9×10^5 kWH).

The solar pond provides the potential of low-cost solar energy collection and long-term storage of low-temperature heat. It is relatively easy to operate and needs little maintenance. A current estimate of the cost of heating using the solar pond is approximately 1.86 cents per kWH, which is competitive with heating by fuel oil. With the increasing cost of fuel oil, the use of solar ponds will become more attractive.

Solar ponds have a wide range of potential applications including residential, industrial, and agricultural. They can be used for water heating, space heating and cooling for residential and commercial buildings. Industrial applications include water

and air heating for process and food industries. Crop drying, shelter heating, and alcohol production are potential candidates for agricultural applications.

The third aspect of this energy related session was that of long-term storage of ice for cooling living or working space area using passive solar techniques. The objective of this research program is to develop a cost-effective method of passive-cooling needs. This work was an extension of efforts in applying Solar Energy to the heating and cooling of buildings. High performance photothermal collectors such as these can be coupled to absorption and/or Rankine cycle machines for the solar cooling of buildings. However, these so-called active solar cooling systems have proven to be mechanically complex and consequently not cost effective. This program was directed to the development of a simple passive-cooling method that would passively freeze and store ice during the winter months to satisfy summer cooling loads. This cooling method is passive in that it uses passive refrigeration devices (heat pipes) which do not use external power but automatically extract heat from a storage container and reject it to the cold air during the winter.

The long-range goal of the Ice Storage for Cooling Applications Program was to develop a method of passive-cooling from the research-prototype stage to industrial commercialization and large scale utilization by the public sector.

The short-term goal of this program was to determine the feasibility of this passive-cooling method based on comprehensive theoretical analyses and experimental measurements.

This cooling method must include a large insulated tank of water buried underground near the building to be cooled. A series of specially designed heat pipes go from the bottom of the tank to the soil surface and project above the surface. These special heat pipes are passive refrigeration devices that do not require external power for operation. During the cold winter months heat is extracted from the water thus forming ice. These heat pipes must be designed so that the ice formed will automatically detach itself from the pipes and fill the storage container during the winter operation. These heat pipes will be low pressure, liquid-vapor cycle units that will probably use anhydrous ammonia as the working fluid. They will provide exceptional one-way heat transfer from the storage water to the air only. During the summer months, the heat pipes are inoperative. Heat pipes such as these have found wide application in foundation and support stabilization in permafrost regions. A detailed analyses of the thermal storage capabilities of the ice tank is a necessary part of the program. However, initial calculations indicate that a 15 ft. high, 15 ft. diameter tank could supply continuous cooling at the one-ton level for 62.2 straight days. It is estimated that a 10-15 ft. tank could provide sufficient cooling capacity for a well-insulated single family home for a cooling year.

The present status of this program is as follows: An extensive survey of literature and recorded data on heat pipe design, fabrication and use has begun. Interaction has started with commercial manufacturers of heat pipes. Experimental equipment is now being assembled to test actual evaporator sections as to ice formation and automatic release. Interaction has also started with solar energy professionals in regard to state-of-the-art storage systems. The future direction of work in this program will determine the feasibility of this passive-cooling method based on substantial theoretical and experimental evidence.

Questions:

Q. To what extent is Argonne National Laboratory continuing to study energy alternatives?

A. Research efforts at Argonne have substantially declined due to the present federal administration's position to reduce funds for basic energy research. Limited or no reductions of funding have occurred for selected defense and nuclear studies.

Q. Has the use of heat pipes been explored for use in greenhouses?

A. Yes. Potentially there is merit to using heat pipes for purposes such as ice storage and greenhouse utilizations. The study to be conducted here at ISU by Dr. Ed Francis utilizing heat pipes to create artificially an earth permafrost area is an intriguing area in which basic research activity is needed and should be supported.

Host: Dr. Ed Francis
Recorder: Dr. Hank Campbell

Communications

Lee Davenport, a consultant in telecommunications planning and advanced technology, retired from General Telephone and Electronics Corporation (GTE) in 1981 after having served as chief scientist at the corporate headquarters in Stanford, Connecticut. His duties at GTE included interpreting new technology and forecasting future trends in telecommunications, acting as corporate spokesman with respect to technical areas of interest to GTE and providing advice and counsel to the overall GTE organization on future trends in technology.

This presentation was a continuation of the talk on "Technology Change and Social Impact." Dr. Davenport focused on the communication aspects of the information revolution in electronic techniques. He stated that as the growth of electronic information systems continue in industry, education and in the home, the interconnecting network that ties it all together will fall very heavily on "telephone-like" services. Today, this load is carried almost exclusively by the post office.

It has been suggested that the big CATV network could be used in this communication network. CATV networks are built like a tree and operate with information originating at the trunk and flowing out to the branches and leaves. However, using the same analogy, the leaves on the branches are not able to communicate with one another. In order for this to occur, major modifications to the system would be required. This, of course, would require substantial investments.

There are not many competitors of the "telephone-like" services at the moment, however, companies like Xerox, IBM and a few others are working on microwave-type radio systems that would essentially duplicate the telephone common carrier. As a result of the 1934 Communications Act, every home and business is now interconnected by wires. Voice traffic grows pretty rapidly, 6-12 percent per year, and data traffic is growing anywhere from 25 to 50 percent per year and will really begin to overtake voice traffic in perhaps 10 to 15 years. With all of this traffic growth, the development of the optical fiber has been the answer to a communicator's prayer.

Band width is hard to come by in copper wire systems. Four kilohertz is comparatively easy on copper wire, but trying to get high band widths creates problems. By brute-forcing, it's possible to get copper telephone pairs to carry one and a half billion bits per second. These megabits travel roughly 7,000 feet before they have to be regenerated. They are not amplified, that would amplify noise. This is all handled in a typical telephone cable called T-1 Carrier.

This T-1 Carrier has 1,200 pairs of 22-gauge wire and is carried in a 4" diameter conduit under the street between switching centers or telephone exchanges. Two of the pairs carry one and a half billion bits per second in one direction and another pair carry it in the other direction.

Optical fibers were mentioned previously. They have been around for a long time, but not for communication traffic. Now they are available, five thousandths of an inch in diameter, about like a hair, made of ultra pure glass. One of the properties of glass is high transparency which makes it capable of handling extreme band widths and more communications in pulsed form. Here is a beautiful marriage, we have semi-conductors

and integrated circuits and a digital system for carrying voices. You can bet the telephone industry is going to be all digital and pulse before the turn of the century. Digital telephones will change your voice into pulses at the microphone.

Th first optical fiber cable built by General Cable and installed by General Telephone had six fibers in it, but it was questionable if it could be installed under the streets without breaking all of the fibers. It had layers of aluminum, paper, plastic and more plastic for armor protection. Today, it is flexible, bendable, spliceable, and goes under the street without breaking.

An examination of digitalized voice traffic ould be helpful to put the information of fiber optics into perspective. In 1960, transistors were discrete; there were no integrated circuits. The first traffic carried a digital bit stream of 64 ki'o bits per second, inter-leaving pulses 24 times to generate 1.544 megabits per second for a 24 voice group going over two wires. This system mixed up pulses and analog voices. Today industry uses a PCM system, Pulse-Code Modulation, all little pulses, all dit's, no dah's. This is the standard not Pulse-Amplitude-Modulation or Pulse-Width. The system is quieter, no hum, no noise, no clicks, no lightning, and it can be regenerated every 7,000 feet to go long distances. Clearly, the telephone industry will be an all digital network by the turn of the century. These developments are not limited to telephones. Digital phonograph records are being widely discussed and the technology is available to make them a practical reality.

An overview of developments in optical communications was presented next. In 1960, the first practical laser was developed, and a few years later lasers were used in experiments with TV signals. The major problem with these early lasers was lack of a carrier. In 1970, Corning Glass came along with an ultra transparglass with only about 15 db per kilometer loss. In 1975, experiments carried 96 simultaneous voices in a G-2 carrier at about 6 megabits per second. In 1977 General Telephone of California installed the first fiber optics cable under the streets of Los Angeles. A good example of the potential use of lasers occurred in Fort Wayne, Indiana in 1979. There was a need to expand the transmission lines between two switching centers at Main and North Streets. Twelve of the thirteen ducts were filled with T-1 carrier and installing another T-1 link would mean replacing the entire system by 1985. It was decided to use the new T-3 optical fiber carrier, which is no larger than your finger, to carry the traffic. T-3 has 10 optical fibers carrying 672 voice channels, at a rate of about 40 megabits per second. It can even handle a higher rate than that. This is the equivalent of 36 of the old T-1 carrier. The addition of this single T-3 carrier will provide expansion potential well into the 21st century. In addition to requiring less space, the solid state lasers provide enough power that they need to be regenerated once every 60 km as compared to each 7000 feet for electrical signals.

Advancements in the communications industry can be expected regularly. A new credit card verifier is being used by VISA that can read the card and identify your account for the store in about 15 seconds. Some universities are using cards for student food service to verify meals and adjust food inventory simultaneously.

The final portion of the presentation was a question and answer session. An example follows:

Question: "Is the need for compatibility with your competition restrictive in your technological development?

Answer: To some extent, yes. The telephone industry over the years, however, has grown use to this. That is to say, the investment in existing telephone equipment, which can't all be obsoleted overnight, has required that the telephone industry find systems of accepting and adopting new technological improvements which compliment, but do not obsolete older systems. You've watched touchtone services come in, and they didn't obsolete dial. You've watched us bring in electronic switching systems, which have not obsoleted Strogrer or crossbar switches of the type that were used long ago. You've watched us bring in electronic T-1 carriers, which allowed us to make use of our older cable, but it will slowly be replaced. For the most part, let me point out that the telephone industry has the luxury of facing a future that is expanding constantly. The telephone industry is growing at a rate of 7 to 15 percent a year in voice traffic. This means that adding facilities is common, in addition to updating technology of existing locations. It does not mean we obsolete everything else in a facility such as Fort Wayne and tear it out. As long as a facility is still useful, and we watch over our investments to see that we operate efficiently, older equipment can be used. So, the answer to your question is of course there are some problems with new technology, in not being able to obsolete old stuff, but it's a life we have learned to live with, and we have been making pretty good use of the technique of adding fresh equipment.

I would expect that if equipment is replaced at 6 or 7 percent a year there would be very little old equipment left 17 years from now. Not only will it be worn out and depreciated, but it will be such a small percentage anyway of what the total telephone plant will look like then that removing it will be negligible. So I see an evolution over the 17 years to a fully digital network of lots of optical fibers and so on, by the year 2000.

Host: Dr. Stan Aman
Recorder: Mr. Don Samdahl

Transportation

Philip Mazziotti is a consultant in the transportation industry with a specialty in power transmission systems. He is the immediate past president of the Society of the Automotive Engineers (SAE). Mr. Mazziotti retired in May of 1982 after 41 years with Dana Corporation in Toledo, Ohio where he served as general manager, director of research and director of engineering. His most recent position was vice president for product engineering. Mr. Mazziotti studied both mechanical and industrial engineering at the University of Toledo where he has been a faculty member. He is active in professional engineering societies.

Phillip Mazziotti received a BSME degree from the University of Toledo. He also completed the Harvard Business School Advanced Management Program. He joined Dana Corporation in 1941 and became the Chief Engineer of the Universal Joint Division in 1953. In 1970 he assumed the position of the president of the Spicer Universal Joint Division. The Society of Automotive Engineers elected him president of the SAE in 1981.

The Society of Automotive Engineers has been a strong advocate of continuing education. Technical Education is important to the transportation industry in the face of rapidly changing technology, and declining availabilities of natural resources.

When considering the long range global transportation environment in the future, the following observations should be noted:

1. The needs of the world for transportation will not diminish.
2. There will continue to be demand for a liquidity of personal mobility.
3. All modes of commerce shall be used to bring products to the consumer.
4. Mass communication will enable the consumer to know where to travel to get to events.

Further, these demands for transportation will place a heavy burden on dwindling energy resources. In the forseeable future, oil will be the predominate source of energy required in the transportation sector. This will necessitate a great deal of planning. Alternative fuels present all kinds of possibilities, however their growth will be inhibited by the lag time required to develop and manufacture the mechanisms that may utilize these sources.

New advances in material will enable us to optimized the use of these materials. It will be necessary to carefully consider the availability of the materials to their costs. This will be important in order to keep transportation systems affordable.

In order to have effective transportation systems in the future, we will need to place careful emphasis on these eleven basic elements of the transportation system:

1. Basic Research
2. Materials Extraction & Recovery
3. Design & Development
4. Testing & Proving
5. Facilitating & Tooling
6. Producing, Fabricating
7. Quality Surveillance

8 Product Marketing
9 Product Operation
10 Product Maintenance
11 Recycling Materials

As the transportation system becomes more sophisticated and complex, education will become increasingly important. The industry is addressing concerns that cannot be ignored. If the industry fails to respond to these concerns, government will establish policy and regulations. These concerns are the environment, internationalism, international standards, and energy. Only if we do our jobs will government not intrude.

Thus, education will be called upon to provide the fuel for the talent that will be required to meet the challenges that we will face in the coming years. Industry is running out of high paying jobs for unskilled workers. In order for education to meet the needs of industry for training the workers of tomorrow it must become more efficient and affordable. The educational system must emphasize the basics as well as provide the learner with exposure to modern tools. Further, as technology increases in complexity, the educational system must provide a means to update people to work within the new environment. The learner should be exposed to a broad range of technological subjects, and a deep knowledge of specialization.

If this is to occur, educators must use the knowledge that is available. The curriculum must be assembled and delivered with constant monitoring of the outcome of the process. Every opportunity should be used to expose the learner to methods of collecting information and conducting research using computer technology. We should show the learners how the computer can work for them, and not the other way around.

In summary, the following points should be emphasized: 1) education must be made more effective, 2) we must make the best possible use of the talents of the faculty, 3) where possible, emphasize the applied technology rather than theoretical science, 4) we need a spirit of international cooperation, and 5) we should develop worldwide data bases that will enable us to maximize the efficient use of world resources.

Host: Mr. Bill Estrem
Recorder: Dr. Charlie Pendieton

Curriculum Implications for Technology Education—1990

G. Eugene Martin serves as chairperson and professor of the Department of Technology at Southwest Texas State University in San Marcos. He received his B.S. from Southern Illinois University, M.Ed. from Miami University and Ed.D. from the University of Maryland. Dr. Martin has over 50 publications to his credit and has received many honors, including Laureate Citation from Epsilon Pi Tau and Outstanding Leader in Industrial Arts from the American Industrial Arts Association.

Industrial arts is in a state of transition. The forces causing this movement come from "traditionalists," "technology educationists" and "industry-based educationists" who cannot seem to agree on the direction or purpose of industrial arts in education. The problem, however, is simply one of change. Change is the most constant characteristic in the world today, yet it is difficult for many people to accept or promote. If we become convinced that there is a purpose for change, it becomes necessary to address its direction. Unfortunately too much effort on the direction of change in the discipline of industrial arts has resulted in a poor understanding of the need for change. The classroom teacher wants to know "Why you are doing this" and for "what purpose" before he or she can implement the new philosophy and provide the necessary direction. Until the teachers that apply the concepts in the classroom can identify a purpose for change, it will be impossible to focus on either industrial arts or technology education in the future.

There are seven points that need to be addressed as today's educators consider the identity of "industrial arts."

First, the strong supporters of technology education have an uphill battle to fight. The change in direction from industry-based to technology-based programs may be viewed by many as a radical change. Unless technology educators begin to develop good one-to-one relationships with less receptive educators, it will always be difficult to make the change. Once the feeling of togetherness and understanding are developed, the differences between the technology educators and industrial educators can be more readily defined and discussed.

Second, technology educators are the minority in the industrial arts profession. Those people who attend professional meetings and conferences are generally more aware and involved in the change than those who do not attend. Somehow, the people who are not involved in professional activities need to become informed so we spend less time talking to ourselves and more time talking to others.

Third, acting as a change agent in an educational institution is one of the most difficult tasks one can undertake. In order to promote the industrial arts profession, we have to "sell" the product. We must sell the need to teach about technology. It may even be necessary to seek help from professional public relations experts in order to meet this need.

Fourth, every teacher must possess interactive skills, conceptual skills, and technical skills in order to be successful. Too often the technology educators are labeled as being pure theorists, or technically illiterate. If either of these are true, they need to be

corrected immediately.

Fifth, industrial arts and technology education lack a common theme or definition. There has not been a consensus on what either of these approaches are or what their direction should be, as evidenced by the divergent philosophies presented in journals, research efforts, and conference proceedings.

Sixth, the existing professional population does not want to become bothered by "new" ideas. Most of the educators claim that they don't have the time to get involved in a new approach while the students, for the most part, are pleased with the present emphasis on tool skills and job performance.

Seventh, classroom teachers believe that the new philosophy does not promote "the project." They need to be convinced that new technological studies about windmills, space shuttles, solar collectors, and other innovations may be more applicable and important than making traditional industrial arts projects. The true value of the project is to develop better and more highly educated human beings.

Technological literacy is another focal point that needs to be addressed. What role, if any, can technology education assume in this important endeavor as we move toward the decades of the 1990's and beyond? It is this profession that needs to make the decisions as to what every human being needs to understand about technology in order to live and function in the present and future society. Young people need to understand the forces of change as well as their role in controlling it. By promoting an understanding of the relationship between technology and society, the student will be better able to cope with the changes and respond to the impacts that technology impresses upon their lives.

Promoting technological literacy in schools is not an impossible task. A middle school in Austin, Texas, for example, has incorporated a study of transportation into its curriculum. The students are required to utilize other areas of the school curriculum as a means for learning. Instructional strategies such as observing, inquiring, analyzing, communicating, and interpreting are utilized. Industrial arts in this middle school reinforces concepts learned in reading, writing, and arithmetic while developing a technological literacy among every girl and boy.

A curriculum effort undertaken by Southwest Texas State University has recently become involved in promoting technological literacy by fieldtesting units in power, energy, transportation, and visual communication. Students enrolled in these programs become deeply involved in understanding the technological nature of the present society by trying learning activities that are unlike traditional industrial arts projects. These students construct models of space shuttles, experiment and analyze vehicular construction materials, make models of hydroelectric and wind generating units, design energy puzzles and games, calculate torque and force, debate the pros and cons of nuclear energy, and become involved in other exciting and innovative projects that help encourage a better understanding of technology.

It is evident that the field of industrial arts is changing and that technology educationists have more obstacles to conquer before they become the majority, rather than the minority. They need not be afraid to change in order to face the future and strive for the very best.

Host: Dr. Franzie Loepp
Recorder: Ms. Sharon Brusic

Technology Education Symposium IV
Friday, October 22 & Saturday, October 23, 1982
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Technology Symposium V

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